

1 Claims

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3 1. A radar antenna assembly for use as a transmitter,
4 receiver or transceiver comprising:

5 a tubular casing having a radar-reflective inner
6 surface and having a first end, a second end and a
7 longitudinal axis;

8 a radar-reflective reflector closing said first
9 end;

10 an aperture disposed at said second end;

11 at least one elongate antenna element extending
12 substantially parallel to said longitudinal axis from
13 said reflector towards said second end; and

14 dielectric material substantially filling the
15 interior volume of said tubular casing.

16

17 2. A radar antenna assembly as claimed in Claim 1,
18 further including focussing means at said second end.

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20 3. A radar antenna assembly as claimed in Claim 2,
21 wherein said focussing means includes a plurality of
22 concentric slit ring apertures located at said second
23 end.

24

25 4. A radar antenna assembly as claimed in Claim 2 or
26 Claim 3, wherein said focussing means includes at least
27 one dielectric lens element located at said second end.

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29 5. A radar antenna assembly as claimed in Claim 4,
30 wherein said dielectric lens element comprises a planar
31 lens element.

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1 6. A radar antenna assembly as claimed in Claim 4,
2 wherein said dielectric lens element comprises a plano-
3 concave lens element.

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5 7. A radar antenna assembly as claimed in Claim 4,
6 wherein said dielectric lens element comprises a plano-
7 convex lens element.

8
Sub A 2
9 8. A radar antenna assembly as claimed in any
10 preceding Claim, wherein said tubular casing has an
11 inner diameter D_T of which is an integer multiple of the
12 diameter D_A of said at least one antenna element.

13
14 9. A radar antenna assembly as claimed in any
15 preceding Claim, wherein said tubular casing has an
16 interior length L_T which is an integer multiple of the
17 length L_A of said at least one antenna element.

18
19 10. A radar antenna assembly as claimed in any
20 preceding Claim, wherein an interior surface of said
21 tubular casing comprises an antenna cathode and said
22 elongate antenna element comprises an antenna anode.

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24 11. A radar antenna assembly as claimed in Claim 10,
25 wherein said elongate antenna element extends along
26 said longitudinal axis.

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28 12. A radar antenna assembly as claimed in any one of
29 Claims 1 to 9, including at least two of said elongate
30 antenna elements, at least one of which comprises an
31 antenna cathode and at least one of which comprises an
32 antenna anode.

1
2 13. A radar antenna assembly as claimed in Claim 12,
3 wherein said elongate antenna elements are disposed
4 symmetrically about the longitudinal axis of the
5 tubular casing.

6
7 14. A radar antenna assembly as claimed in Claim 13,
8 wherein said elongate antenna elements have
9 substantially equal lengths and diameters.

10
11 15. A radar antenna assembly as claimed in Claim 14,
12 wherein the interior diameter D_T of the tubular casing
13 is an integer multiple of the diameter D_A of said
14 elongate antenna elements and of the spacing between
15 adjacent pairs of said elongate antenna elements.

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17 16. A radar antenna assembly as claimed in any
18 preceding Claim, wherein said dielectric material is a
19 liquid.

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21 17. A radar antenna assembly as claimed in any
22 preceding Claim, wherein said dielectric material is a
23 solid.

24
25 18. A radar antenna assembly as claimed in any
26 preceding Claim, wherein said dielectric material is a
27 powdered solid packed into the interior of said tubular
28 casing.

29
30 19. A radar antenna assembly comprising a closed
31 chamber adapted to contain a sample of material, said
32 chamber including four substantially triangular side

1 walls together defining an open-based pyramidal
2 structure, said assembly including transmitter antenna
3 elements disposed on interior surfaces of a first
4 opposed pair of said triangular side walls and receiver
5 antenna elements disposed on interior surfaces of a
6 second opposed pair of said triangular side walls.

7
8 20. A radar antenna assembly as claimed in Claim 19,
9 wherein said antenna elements comprise bowtie dipole
10 antennas with respective cathode and anode elements
11 disposed on said opposed pairs of said triangular side
12 walls.

13
14 21. A radar antenna apparatus as claimed in Claim 19
15 or Claim 20, wherein the base of said pyramidal
16 structure is closed by a generally planar base wall,
17 said chamber comprising the interior volume of said
18 pyramidal structure.

19
20 22. A radar antenna assembly as claimed in Claim 19 or
21 Claim 20, wherein said chamber comprises a closed
22 volume communicating with the open base of said
23 pyramidal structure.

24
25 23. A radar system comprising pulsed signal generating
26 means, transmitter antenna means, receiver antenna
27 means, control means for controlling the operation of
28 said pulsed signal generating means, analog-digital
29 converter means for digitising signals received by said
30 receiver antenna means, and data storage means for
31 storing said digitised signals, wherein said
32 transmitter antenna means and receiver antenna means

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1 comprise at least one radar antenna assembly as claimed
2 in any one of Claims 1 to 22.

3
4 24. A radar system as claimed in Claim 23, wherein
5 said transmitter antenna means comprises at least one
6 transmitter radar antenna assembly as claimed in any
7 one of Claims 1 to 18, and said receiver antenna means
8 comprises at least one receiver radar antenna assembly
9 as claimed in any one of Claims 1 to 19.

10
11 25. A radar system as claimed in Claim 24, wherein
12 said transmitter and receiver antenna assemblies are
13 disposed so as to transilluminate a subject.

14
15 26. A radar system as claimed in Claim 24, wherein
16 said transmitter and receiver antenna assemblies are
17 disposed so as to be co-axially aligned on opposite
18 sides of a subject.

19
20 27. A radar system as claimed in any one of Claims 24
21 to 26, wherein said transmitter and receiver antenna
22 assemblies are connected to a closed sample chamber
23 adapted to enclose a subject.

24
25 28. A radar system as claimed in Claim 24, wherein
26 said transmitter and receiver antenna assemblies are
27 disposed such that said receiver antenna assembly
28 receives a signal transmitted by said transmitter
29 antenna assembly and reflected from a subject.

30
31 29. A radar system as claimed in Claim 28, wherein
32 said transmitter and receiver antenna assemblies are

1 arranged such that their longitudinal axes are
2 substantially parallel to one another with their second
3 ends facing in the same direction.

5 30. A radar system as claimed in Claim 28 or 29,
6 wherein said system is adapted to be portable.

8 31. A radar system as claimed in Claim 28 or Claim 29,
9 wherein said system is adapted to be carried by a land
10 vehicle.

12 32. A radar system as claimed in Claim 28 or Claim 29,
13 wherein said system is adapted to be carried by a
14 water-borne vessel.

16 33. A radar system as claimed in Claim 28 or Claim 29,
17 wherein said system is adapted to be carried by a
18 submersible vehicle.

20 34. A radar system as claimed in Claim 28 or Claim 29,
21 wherein said system is adapted to be carried by an
22 airborne vehicle.

24 35. A radar system as claimed in Claim 28 or 29,
25 wherein said system is adapted to be carried by a space
26 vehicle.

36. A radar system as claimed in Claim 28 or Claim 29,
wherein the position of said transmitter antenna
assembly is fixed relative to said receiver antenna
assembly.

1 37. A radar system as claimed in Claim 28 or Claim 29,
2 wherein at least one of said transmitter antenna
3 assembly and said second antenna assembly is adapted to
4 be movable relative to a subject.

5
6 38. A radar system as claimed in Claim 28 or Claim 29
7 in which one of said transmitter and receiver antenna
8 assemblies is adapted to be movable relative to the
9 other.

10
11 39. A radar system as claimed in any one of Claims 28
12 to 38, including a plurality of transmitter antenna
13 assemblies.

14
15 40. A radar system as claimed in any one of Claims 28
16 to 39, including a plurality of receiver antenna
17 assemblies.

18
19 41. A radar system as claimed in any one of Claims 28
20 to 40, for use with close range subjects, in which said
21 control means is adapted to control said pulsed signal
22 generating means so as to generate pulses with a pulse
23 repetition frequency of the order of 100 kHz.

24
25 42. A radar system as claimed in any one of Claims 28
26 to 41, for use with close range subjects, in which said
27 control means is adapted to control said pulsed signal
28 generating means so as to generate pulses with a pulse
29 width in the range 0.01 to 0.1 nanoseconds.

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1 43. A radar system as claimed in any one of Claims 28
2 to 42, for use with close range subjects, adapted to
3 capture data in a time range of 2 to 25 nanoseconds.

44. A radar system as claimed in any one of Claims 28 to 43, for use with close range subjects, adapted to transmit pulses with a minimum frequency in the range 100 to 1000 MHz and with a maximum frequency in the range 1000 to 10000 MHz.

11 45. A radar system as claimed in any one of Claims 28
12 to 40, for use with close to medium range subjects, in
13 which said control means is adapted to control said
14 pulsed signal generating means so as to generate pulses
15 with a pulse repetition frequency of the order of 25 to
16 100 kHz.

18 46. A radar system as claimed in any one of Claims 28
19 to 40 or 45, for use with close to medium range
20 subjects, in which said control means is adapted to
21 control said pulsed signal generating means so as to
22 generate pulses with a pulse width in the range 1 to 10
23 nanoseconds.

25 47. A radar system as claimed in any one of Claims 28
26 to 40, or 45 or 46, for use with close to medium range
27 subjects, adapted to capture data in a time range of
28 2000 to 10000 nanoseconds.

48. A radar system as claimed in any one of Claims 28 to 40, or 45 to 47, for use with close to medium range subjects, adapted to transmit pulses with a minimum

1 frequency in the range 12.5 to 125 MHz and with a
2 maximum frequency in the range 200 to 2000 MHz.
3

4 49. A radar system as claimed in any one of Claims 28
5 to 40, for use with long range subjects, in which said
6 control means is adapted to control said pulsed signal
7 generating means so as to generate pulses with a pulse
8 repetition frequency of the order of 3.125 to 50 kHz.
9

10 50. A radar system as claimed in any one of Claims 28
11 to 40 or 49, for use with long range subjects, in which
12 said control means is adapted to control said pulsed
13 signal generating means so as to generate pulses with a
14 pulse width in the range 10 to 25 nanoseconds.
15

16 51. A radar system as claimed in any one of Claims 28
17 to 40, or 49 or 50, for use with long range subjects,
18 adapted to capture data in a time range of 20000 to
19 250000 nanoseconds.
20

21 52. A radar system as claimed in any one of Claims 28
22 to 40, or 49 to 51, for use with long range subjects,
23 adapted to transmit pulses with a minimum frequency in
24 the range 1 to 12.5 MHz and with a maximum frequency in
25 the range 12.5 to 200 MHz.
26

27 53. A radar system as claimed in any one of Claims 23
28 to 52, further including data processing means for
29 processing said digitised signals.
30

31 54. A radar system as claimed in Claim 53, wherein
32 said data processing means is adapted to process said

1 digitised signals for the purposes of at least one of
2 imaging, measuring, mapping, detecting, identifying and
3 typecasting said subject.

4
5 55. A method of typecasting a subject comprising the
6 steps of:

7 irradiating the subject with a pulsed, broad band
8 radar frequency signal transmitted by at least one
9 transmitter antenna;

10 detecting a return signal following interaction of
11 said transmitted signal with said subject, using at
12 least one receiver antenna;

13 calculating an energy-frequency spectrum of said
14 return signal; and

15 analysing said energy-frequency spectrum to obtain
16 a characteristic energy-frequency signature of said
17 subject.

18
19 56. A method as claimed in Claim 55, wherein said step
20 of analysing said energy-frequency spectrum comprises
21 performing a statistical analysis of said energy
22 frequency spectrum.

23
24 57. A method as claimed in Claim 56, wherein said
25 statistical analysis includes at least one of principal
26 components analysis, maximum likelihood classification
27 and multivariate classification.

28
29 58. A method as claimed in any one of Claims 55 to 57,
30 wherein said step of analysing said energy-frequency
31 spectrum comprises frequency classification using
32 energy bins.

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59. A method as claimed in any one of Claims 55 to 57,
wherein said step of analysing said energy-frequency
spectrum comprises energy classification using
frequency bins.

6 60. A method of identifying an unknown subject
7 comprising the steps of:

8 obtaining an energy-frequency signature of said
9 subject using the method of any one of Claims 55 to 59;
10 and

11 comparing said energy-frequency signature of the
12 unknown subject to a database of energy-frequency
13 signatures of known subjects previously obtained using
14 the method of any one of Claims 55 to 59.

16 61. A method as claimed in any one of Claims 55 to 60,
17 implemented using a radar system as claimed in Claim 53
18 or 54.

62. A radar system as claimed in Claim 53 or 54,
wherein said data processing means is adapted to
perform the method of any of Claims 55 to 60.